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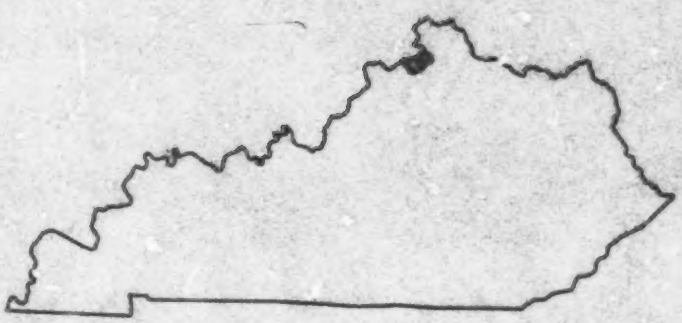
594-C-17 COMPLETED FEMA

FLOOD INSURANCE STUDY

ORIGINAL

CITY OF WARSAW, KENTUCKY

GALLATIN COUNTY



AUGUST 19, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER -210080

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

CITY OF WARSAW, GALLATIN COUNTY, KENTUCKY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Warsaw, Gallatin County, Kentucky, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared originally for purposes other than the National Flood Insurance Program. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. The Federal Emergency Management Agency (FEMA) performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the National Flood Insurance Program. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, FEMA, Atlanta, Georgia, for consideration for revision of this study.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were obtained from the "Ohio River Profiles" (Reference 1).

1.3 Coordination

On September 26, 1986, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Warsaw, Gallatin County, Kentucky. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

Flooding caused by overflow of the Ohio River was studied in detail within the corporate limits.

2.2 Community Description

The City of Warsaw is located in northwestern Gallatin County in north-central Kentucky, and is surrounded by the unincorporated areas of Gallatin County. Warsaw is about 27 miles southwest of the City of Cincinnati, Ohio, and 53 miles northeast of the City of Louisville. According to the 1980 census, the population of Warsaw is 1,328 (Reference 2).

The climate is typical of the Midwest, with hot, humid summers and temperatures averaging 80 degrees Fahrenheit (F.) in July and cold winters with temperatures averaging 30 degrees F. in January. The average rainfall per year is 40 inches (Reference 3).

2.3 Principal Flood Problems

Areas along the Ohio River, including the Towns of Lamb, Vevay, Markland, Florence, and Patriot, are subject to fooding caused by the overflow of the Ohio River. The most noted of these floods were those of 1832, 1847, 1857, 1883, 1884, 1913, 1937, and 1964. The flood of 1937 is the worst on record and is considered to be greater than a 500-year frequency flood. The 1937 flood reached a crest of 84.9 feet National Geodetic Vertical Datum of 1929 (NGVD) in Vevay and reached a crest of 81.9 feet NGVD in Patriot, both of which were 10.8 feet higher than the recorded crests of the flood of 1884. No monetary estimates of flood damage in the entire county were available, but in Patriot, 21 businesses and 94 homes were damaged by the floodwaters (Reference 3).

2.4 Flood Protection Measures

Due to the parameters of this existing data study, information regarding flood protection measures in the community is obtained only from the source report (Reference 1) and any other readily available sources. None of these sources provided information relating to the flood protection measures in the community.

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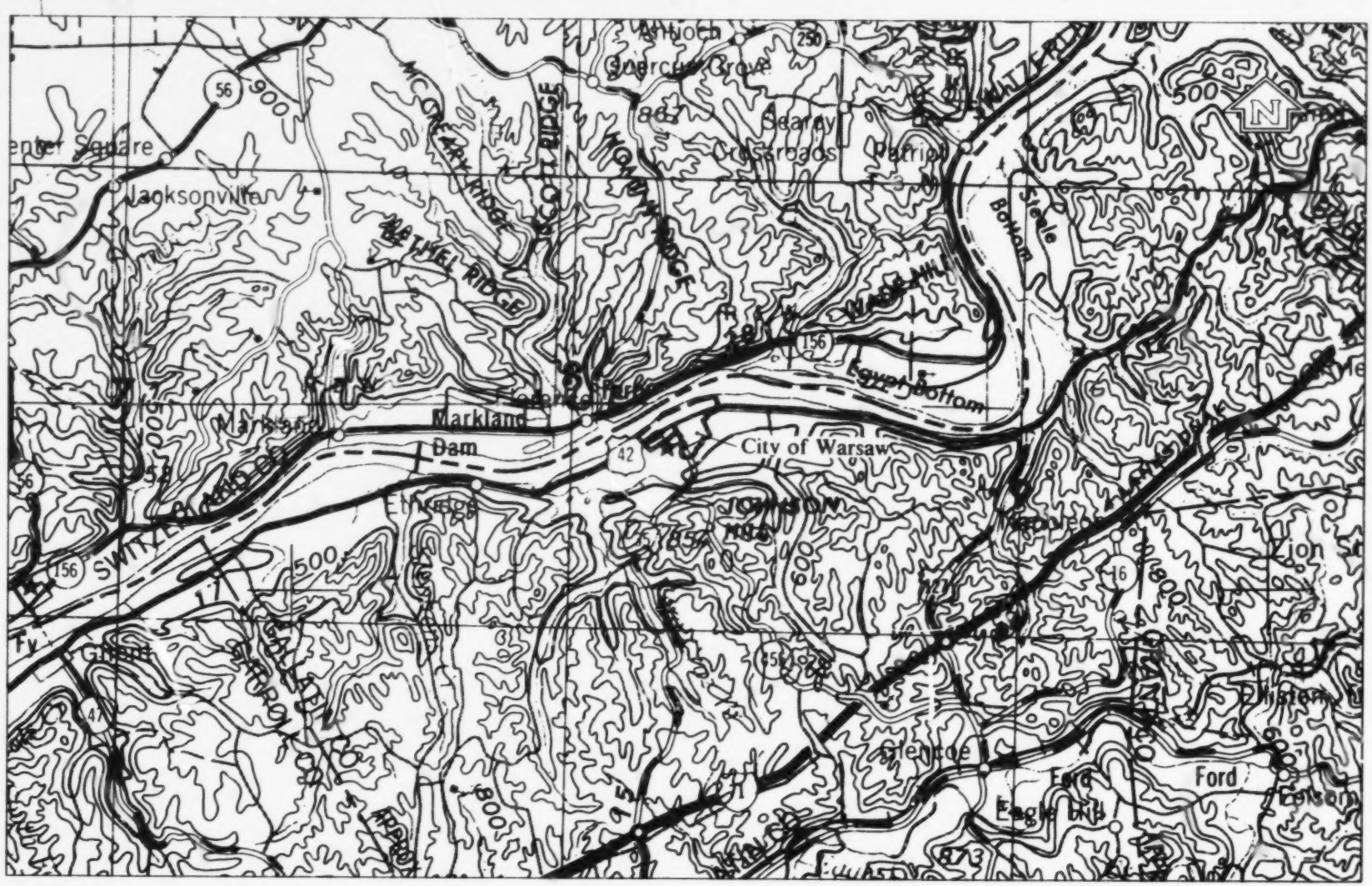

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WARSAW, KY

(GALLATIN CO.)

APPROXIMATE SCALE

2 0 2 4 6 MILES

VICINITY MAP

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (one-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The following information is principally taken from the "Ohio River Basin, Comprehensive Survey" (Reference 4).

Frequency data for the Ohio River were supplied by the U.S. Army Corps of Engineers (COE), Ohio River Division Office. Natural maximum annual frequency curves were developed by the COE in accordance with "Statistical Methods in Hydrology" (Reference 5).

The computed natural statistics (mean, standard deviation, and coefficient of skew) for the entire period of record were adjusted by reconciling adjacent points and comparison on drainage area proportions to produce consistent statistics throughout the length of the main stem. Stage frequency curves were developed by converting flows to stage through the use of crest stage-maximum discharge relationships plotted from historical data and extended rating curves prepared in connection with the Ohio River Standard Project Flood (SPF) study.

To determine modified flood peaks on the Ohio River, 12 historical floods, plus 3 hypothetical ones of greater magnitude were used in the analyses of flow modification. The flows of these 15, considered representative of the basin, were modified by the operation of COE reservoirs, completed or under construction.

Frequency curves for the reservoir modified discharges were developed for 20 locations on the main stem of the Ohio River. The discharges in the following table are at nearest gage to the particular study locations.

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Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
OHIO RIVER at Markland, Indiana (river mile 532.0)	82,000	565,000	703,000	760,000	1,000,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

The following information is principally taken from the "Ohio River Basin, Comprehensive Survey" (Reference 4).

To determine the effect of the combination of reservoirs on tributary or main stem flow, stream regulation studies and system analyses are required. The COE reservoirs have been studied, but impoundments operated by others were not considered, with the exception of the Tennessee Valley Authority.

The 10-, 50-, and 100-year flood elevations were taken from the COE January 1981 water-surface profiles, which reflect the reductions of flow provided by Group A Reservoirs. Only upstream reservoirs affect floodflows at the study site.

Previously established flood routing procedures for the branches and upstream reaches of tributaries were used for this study. For the main stem and the lower reaches of major tributaries, the method and routing coefficients for the SPF studies are applicable to large floodflows. Therefore, profiles were determined by flood routing and backwater computations as pertinent for the reach and the frequency of the flood.

A method of determining the effect of impoundments on floodflows is by reservoir holdout. The difference between a natural hydrograph and one resulting from the reservoir modification is routed downstream. This is to determine the lowering of crest discharge due to storage effects using the standard methods explained in COE Engineering Manual 1110-2-1408 (Reference 6). This is generally simpler than routing the modified hydrograph, which must be combined with tributary inflow. The routing of floods and reservoir holdouts, programmed on an electronic computer by the COE, Ohio River Division, was used for this study.

The term SPF is defined as a hypothetical flood, representing the critical volume and peak discharge that may be expected from a combination of meteorologic and hydrologic conditions reasonably characteristic of the

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geographical region. It represents a standard against which the degree of flood protection selected, called the Project Design Flood (PDF), may be judged and compared with protection provided by similar projects in other localities.

Following the flood of January-February 1937, studies of a comprehensive flood control plan for the Ohio River basin were made. These included the determination of an SPF for the main stem of the Ohio River. The system of reservoirs recommended on the basis of the 1937 study, essentially that authorized by the 1938 Flood Control Act and prior acts, would reduce the project flood to stages close to the maximum of record along the Ohio River from Wellsville, Ohio, to the mouth. The PDF profile then selected for construction of local protection works was established as the modified SPF between Pittsburgh and Wellsville, and the maximum flood of record between Wellsville and Cairo.

Subsequent to establishment of the 1937 PDF, changes have occurred that make construction of some of the presently authorized reservoirs impractical. Because of these and in light of accumulated experience, the latest developments in meteorologic and hydrologic techniques and currently available data, a reappraisal of the SPF was made and reported in the "Ohio River Basin, Comprehensive Survey" (Reference 4); however, there were no adjustments made to the PDF.

For purposes of this Flood Insurance Study, the PDF is considered similar to the 500-year flood in magnitude of the event and is shown as the 500-year flood.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals. In cases where the 50- and 100-year flood elevations are close together, due to limitations of the profile scale, only the 100-year profile has been drawn.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the NGVD.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the one-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2-percent annual

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chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using topographic maps at a scale of 1:24000 with a contour interval of 20 feet (Reference 7).

The 100- and 500-year flood plain boundaries are indicated on the Flood Insurance Rate Map. On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100-and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. No floodway has been computed for this reach at the Ohio River.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

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For flood plain management applications, the map shows by tints, screens, and symbols the 100- and 500-year flood plains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Preparation of the Flood Insurance Study for the Unincorporated Areas of Gallatin County has begun (Reference 8). However, work has not progressed sufficiently to date to permit a comparison with the determinations contained in this report.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Warsaw (Reference 9).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

9.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Army Corps of Engineers, Ohio River Division, Ohio River Profiles, Cincinnati, Ohio, January 1981.

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5. ————, Sacramento District, Office of the Chief, Statistical Methods in Hydrology, Leo R. Beard, July 1952 and January 1962.

6. ————, Engineering Manual, EM 1110-2-1408.

7. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 20 Feet: Florence, Indiana-Kentucky, 1966.

8. Federal Emergency Management Agency, Flood Insurance Study, Gallatin County, Unincorporated Areas, Kentucky, in progress.

9. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Warsaw, Gallatin County, Kentucky, April 1976.

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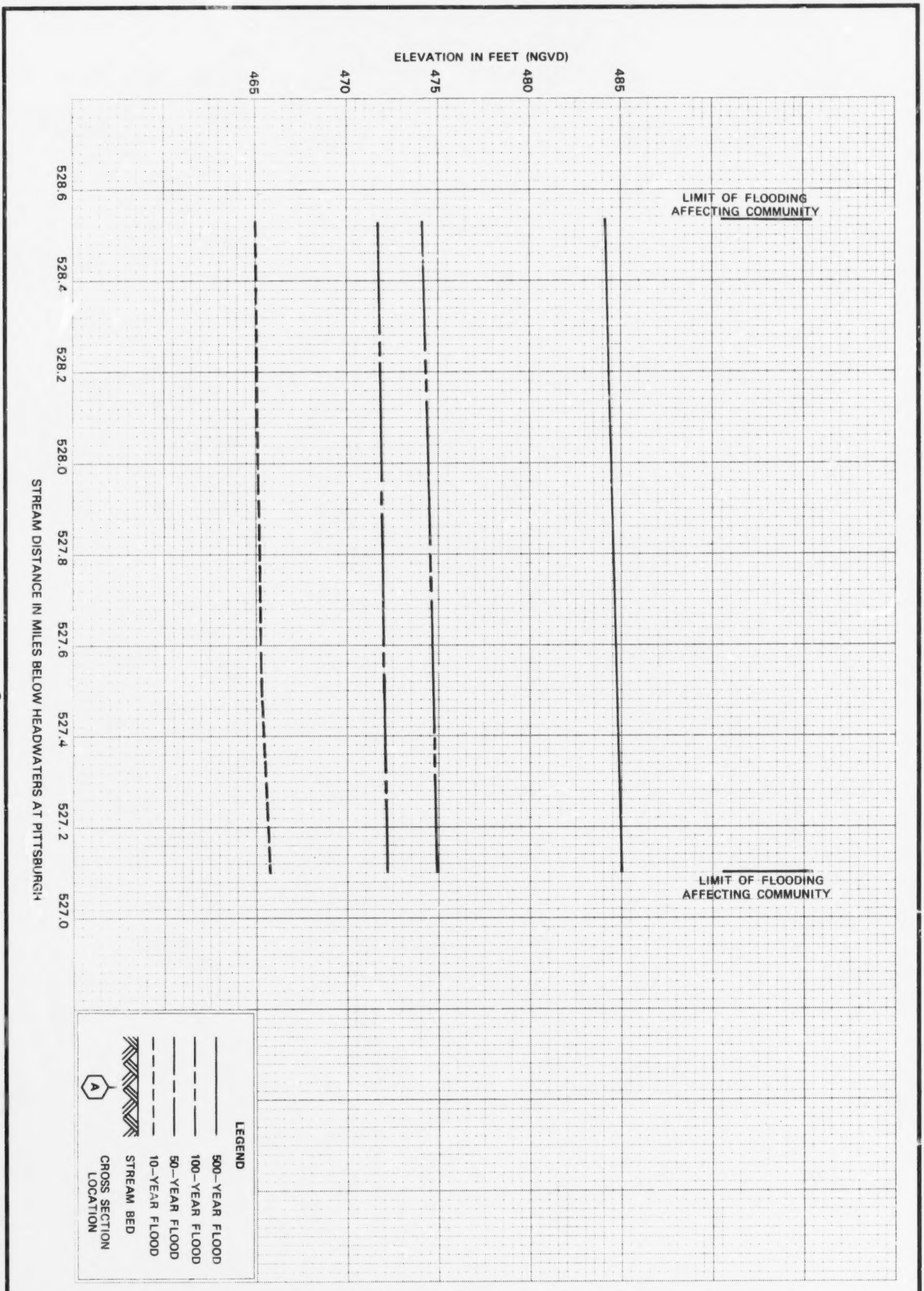

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WARSAW, KY

(GALLATIN CO.)

FLOOD PROFILES

OHIO RIVER

01P

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